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ONTARIO

Department of Education

Courses of Study

Grades IX, X, XI
and XII

GENERAL SHOP

Issued by Authority of
The Minister of Education

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GENERAL SHOP

The General Shop Courses are designed to give the pupils some acquaintance with trade and industrial practices, to enable them to discover their interests and aptitudes for shop work, and to provide for the development of skills and the acquisition of knowledge fundamental to non-specialized industrial operations and processes commonly found about the farm, the home and the local shops.

Drafting is obligatory and any three of the following may be selected: applied electricity, farm mechanics, forge and vise work, machine shop practice, ornamental metal work, motor mechanics, sheet metal work, woodwork. Any other practical subject approved by the Minister may be substituted for one of the optional subjects. Where it is desired to offer a wider range of shop work, parts of the optional subjects may be selected, subject to the approval of the Minister, provided that the parts selected are in the aggregate equivalent to three optional subjects.

SUGGESTIONS FOR THE USE OF THE COURSES

The project is the usual medium for the presentation of shop instruction. Projects to cover the topics of the courses should be selected with a view to the interests and abilities of the pupils and should be related to the local trades and industries. A variety of projects is essential.

The plan of the general shop necessitates simultaneous instruction in a number of varied activities. Shop libraries, illustrative materials, and other lesson aids carefully organized to direct pupil effort will be found of valuable assistance in the carrying on of instruction, and in the general administration of the shop. Tools and other equipment should be properly stored in cabinets provided for the purpose and made readily accessible to the pupils as required. Each job or operation performed by the student should be appraised and recorded promptly by the instructor.

The nature and extent of the available equipment and the immediate aims of the teaching in the shop work undertaken will determine the selection and arrangement of the topic from the following courses of study. From these courses the teacher should make a detailed organization of the work for each class.

Dangerous conditions affecting the health and safety of the pupils must be avoided. Exhaust gases from running engines and fumes from heat treating processes and the like must be effectively discharged. All machines must be properly guarded, safety instruction must be given wherever hazards exist, and a first-aid cabinet must be readily accessible. A clean and well-appointed shop with equipment maintained in first-class operating condition is an important factor in the prevention of accidents.

GRADE IX

DRAFTING

1. Drafting Instruments:

The use and care of the elementary drafting instruments: T-square, set square, pencil, scale and compasses.

2. Lines:

The purpose and characteristics of the outline, hidden outline, centre line, construction line, extension line, dimension line and arrowhead.

3. Lettering:

Single stroke freehand alphabet; figures and fractions; size, slant and spacing; horizontal and slant guide lines. Application in notes and dimensions.

4. Working Drawings:

- (a) Simple freehand sketching of working drawings from isometrics to illustrate the correct placement and projection of views.
- (b) Two and three-view working drawings to full size, of
 - (1) Simple rectangular objects.
 - (2) Angular objects formed of straight lines, such as wedges, hexagonal or octagonal objects.
 - (3) Circular or semi-circular objects, requiring the locating and dimensioning of circular openings and holes.
- (c) Dimensioning.
- (d) Sectional views; methods of indicating the section and the materials.
- (e) Geometrical constructions as required.

5. Blueprint Reading:

Interpreting simple blueprints of familiar objects and shop projects.

APPLIED ELECTRICITY

1. Signal Circuits:

- (a) Symbols used in electrical diagrams of signal circuits.
- (b) Sketch diagrams for and the installation of circuits such as—
 - (1) Bell controlled by two or more buttons.
 - (2) Two bells controlled by one button.
 - (3) Front and back door bell system.
 - (4) A return call system.
 - (5) Elementary telegraph or telephone system

2. Joints:

- (a) Western Union, tap and rat-tail joints in No. 18 gauge wire.
- (b) Soldering and taping; the use of the soldering iron.

3. The Dry Cell:

An experimental study of dry cells connected in (1) series, (2) parallel; the use of the voltmeter.

4. Magnetism and Electro-magnetism:

- (a) Plotting the magnetic field about a permanent magnet by the use of iron filings or small compasses.
- (b) Making an electro-magnet; plotting its magnetic field; polarity of an electro-magnet.
- (c) The field of force about a single wire carrying a current; development of the "right hand" rule.

5. Conductors and Insulators:

An experimental study of a few common metals and non-metals as a basis for their classification into conductors and non-conductors.

6. Apparatus:

A study of the action of the electric bell or buzzer, and the annunciator.

7. Wiring:

Making an extension cord or wiring a table lamp; making or repairing an appliance cord.

FARM MECHANICS

1. Paints and Finishes:

Paints for wood, iron, and concrete; preparation of surfaces; home-mixed and ready-mixed paints; white washes; the care of brushes.

2. Rope Work:

Kinds and grades of rope; uses of rope on the farm; care of rope; whipping a rope end; crowning and tucking a rope end; making a short splice; common knots and their uses.

3. Belt Lacing:

Leather and fabric belts; care of belts; tools required in belt lacing; making of samples of single lacing and double lacing, using cardboard and tape.

4. Harness Repairing:

Cleaning, oiling, and repairing harness; tools and materials needed; making a waxed thread and practice in stitching splices; attaching snaps and buckles.

5. Glazing:

Tools; preparation of putty; value of priming coat on sash; methods of cutting glass; practice in putting glass in new sash or in replacing a broken pane.

6. Pipe Fitting:

Black and galvanized iron pipe; cutting, reaming, threading; use of couplings, elbows, tees, reducers; measuring runs and making layouts.

FORGE AND VISE WORK

1. Equipment and Materials:

Trade description of such tools, equipment and materials as may be required for this course.

2. The Forge Fire:

Selection of fuels; arrangement of fuels and proper maintenance of fire; temperatures required for metal working.

3. Forge Operations:

Heating; cutting with hot or cold set; bending, drawing, upsetting; forging a flat; punching.

4. Vise Work Operations:

(a) Laying out; cutting with hack saw, filing; drilling (hand drill), countersinking, riveting; finishing.

(b) Tapping and threading; tapping a through hole; relation of tap and drill sizes; precautions; use of proper cutting oil; threading with a die.

MACHINE SHOP PRACTICE

1. Hand Tools and Bench Work:

Trade description and use of such tools and equipment required for this course as soft and hard hammers, chisel, punch, file, hack saw, and vise.

2. Layout Work:

(a) Coating of metal surfaces (copper sulphate, chalk) to facilitate layout.

(b) Use of steel rule, dividers, scribe, hermaphrodite caliper and punch in laying out work from blueprints or drawings.

(c) Centering work for drilling.

3. Machine Tools and Operations:

(a) Lathe: names of main parts; setting up work in machine; side facing, rough turning, shoulder turning, finish turning to size and polishing.

(b) Drill press: names of main parts; operation and maintenance; preparation of work for drilling (including marking with centre punch); use of vise for mounting work; selection and mounting of drills; use of cooling and cutting compounds.

(c) Grinder: safety precautions and use of goggles; rough grinding to remove hard skin of material; rough grinding to bring material to size.

ORNAMENTAL METAL WORK

1. Materials:

Copper, brass, aluminum; strap, bar and sheet iron; soft solder and fluxes. Both ferrous and non-ferrous metals to be used; a study to be made, incidental to the making of the project, of the properties of the materials, trade description, stock sizes, gauges.

2. Operations:

(a) Laying out: use of tools such as rule, scribe, centre punch, dividers; coating of surfaces to facilitate layout and transfer of designs to metal; care required to avoid marks.

- (b) Cutting: use of snips, jeweller's saw, files, hack saw and cold chisel.
- (c) Bending, twisting, scroll forming; use of bending forks and scroll forms.
- (d) Raising shallow round, square or oval trays or dishes over wooden blocks with mallet or hammer; annealing, planishing; etching, piercing.
- (e) Drilling: operation and care of drill press; selection and use of drills, use of cutting oils, countersinking.
- (f) Riveting with round head and countersunk rivets; soldering and sweating; threading with taps and dies for small machine screws.
- (g) Finishing: cleaning, buffing, polishing, lacquering, painting.

MOTOR MECHANICS

1. Chassis:

- (a) Parts: a brief examination and study to obtain the general purpose and location of the following parts in tracing the path of power—engine, clutch, transmission, differential.
- (b) Specifications: meaning of wheel base, steering ratio, types of spring suspension.

2. Engine:

- (a) Parts: identify, dismantle, and assemble parts pertaining to a sectioned one-cylinder engine operating on the four-stroke cycle principle.
- (b) Operation: events in the four-stroke cycle including reference to combustion mixtures and dangers of carbon monoxide in exhaust gases.

3. Unit Parts:

- (a) Clutch: examination of a single-plate clutch to observe the function of the foot pedal in the operation of the clutch parts.
- (b) Gear box: examination of simple gear box to discover general arrangement of parts for various gear shift positions and speed ratio of crank shaft to propeller shaft.
- (c) Differential: experimental determination of the main functions of a differential unit.
- (d) Steering: examination of one type.
- (e) Brakes: shoes, drum, and linkages applied to one wheel.
- (f) Ignition: a simple demonstration ignition unit planned to control one cylinder which can be operated by pupils to observe
 - (i) primary and secondary circuits and
 - (ii) spark produced by opening distributor contacts.

SHEET METAL WORK

1. Materials:

- (a) Galvanized sheet iron and tinned iron: common uses, advantages, stock sizes and gauges.
- (b) Solders: common solder, composition, reasons for different alloys.
- (c) Fluxes: purpose; common fluxes and their suitability.

2. Hand Operations and Tools:

- (a) Laying out: use of measuring and marking tools; use of templates; making seam allowances.
- (b) Reinforced edges: single, double and standing folds.
- (c) Cutting: use of straight snips for cutting on straight lines; notching.
- (d) Folding and forming: use of mallet, hammer, stakes, and grooving tools in the construction of simple rectangular objects.
- (e) Soldering:
 - (1) Soldering iron: oxidation, tinning, design for transference of heat.
 - (2) Soldering: heating the iron, correct position of iron, use of flux and solder.

WOODWORKING

The organization of the course should make provision for pupils with previous instruction in manual training in Grades VII and VIII. The content of this course should be modified to suit the needs of the pupils and the equipment available.

1. Materials:

- (a) Lumber: such woods as pine, basswood, whitewood, gumwood, birch and oak; recognition of these and other common woods; processing of lumber; units of measurement and stock sizes.
- (b) Sundries:
 - (i) Glue: kinds, sources, preparation and use.
 - (ii) Hardware: types and specification for common nails, wood screws, and other hardware in common use.
 - (iii) Finishing materials: characteristic properties; uses and limitations of stain, shellac, wax and paints.

2. Hand Tool Operations:

- (a) Bill of material made from blueprint or drawing.
- (b) Laying out; selection of pieces to avoid waste, cutting to a layout plan.
- (c) Sawing: cross-cut and rip.
- (d) Planing: surfaces, edges, ends; at an angle to the grain.
- (e) Squaring: steps in truing to size; use of square and back saw.
- (f) Chamfering: planing and chiselling a chamfer, stop chamfering.

- (g) Chiselling: paring, chiselling curves, perpendicular chiselling; use of mallet
- (h) Shaping: use of coping saw, bow saw, spokeshave and file.
- (i) Boring: use of various types of bits and depth gauge; boring for screws and dowels.
- (j) Fastening: selection and use of nails, screws, glue; clamping.
- (k) Sanding: uses of various grades of sand paper.
- (l) Finishing: staining, shellacking, waxing, and polishing; care of brushes; proper storage of materials; fire hazards.
- (m) Tool sharpening: whetting of plane irons and chisels.

3. Machine Tools and Operations:

The machines must be adequately guarded and the guards kept in place. Operations that cannot be completed with the guards in place shall not be attempted.

- (a) Variety saw: cross-cutting and ripping.
- (b) Scroll saw or band saw, sawing simple scrolls.
- (c) Drill press: boring operations, sanding.
- (d) Jointer: jointing edges.
- (e) Lathe: face plate turning; rough and finish turning to size; shoulder and taper turning, turning simple beads and curves; use of calipers and templates.

GRADE X

DRAFTING

1. Machine Drawings:

Working drawings of simple mechanical objects or tools involving conventional indications, threads, tapped holes, countersunk holes, sections and half-sections.

2. Assembly Drawings:

Assembly drawings to various scales of objects composed of several parts, for which various details are given, such as a book rack, table, cabinet or other shop project.

3. Geometrical Construction:

The construction of regular figures, arcs, tangents, curves, fillets with the drafting instruments to be introduced in the drafting projects.

4. Development of Surfaces:

- (a) Parallel line and radial line methods for layout of patterns—
 - (1) Rectangular objects such as a metal box or dust pan.
 - (2) Cylindrical objects such as a right cylinder, an oblique cut cylinder, two-piece elbow, scoop.
 - (3) Conical objects such as funnel, fruit jar filler.
- (b) Allowances for laps and seams on patterns.

APPLIED ELECTRICITY

1. Series and Parallel Circuits:

- (a) A circuit with a fixed load in which dry cells as a source of current may be added one at a time (1) in series, (2) in parallel, and the general effect on the load observed and recorded.
- (b) A circuit with a constant supply voltage and the load units added one at a time (1) in series, (2) in parallel, and the general effect observed and recorded.

2. Joints, Soldering and Weatherproofing:

Making, soldering and taping tee and rat-tail joints in No. 14 gauge wire.

3. Circuit Protection:

The heating effect of electric current; the simple fuse as a device for protecting circuits and equipment; types of fuses; the safe carrying capacity of standard wires and cables used in the home.

4. Lighting Circuits:

- (a) Branch lighting circuits in both knob and tube and non-metallic sheathing construction such as (i) two lights controlled by a single pole switch, (ii) one light controlled by two three-way switches.
- (b) Examination of a 30-ampere service installation.

5. Electrical Units:

Sufficient experimental acquaintance with elementary circuits to gain the concept of volts, amperes, ohms and watts.

6. Magnetism and Induced Currents:

Discovery of the laws relating to the direction and relative value of an induced current.

7. Instruments:

Parts, theory of operation and location in the circuit for D.C. ammeters and voltmeters.

FARM MECHANICS

1. Tool Sharpening:

Use of grindstone, emery wheel, and oilstone in sharpening flat, keen-edged tools such as plane irons and chisels; grinding cold chisels; saw jointing, setting, and filing.

2. Rope Work and Tackle Blocks:

- (a) Knots and splices: making long splice and eye splice; more difficult knots in heavy rope.
- (b) Pulleys: single fixed, single movable, one fixed and one movable.
- (c) Blocks: double and single; two double blocks.

3. Belt Lacing:

Lacing leather and fabric belts.

4. General Repair Work:

Repair of farm implements and machinery involving operations in wood and metal and painting.

5. Concrete Work:

- (a) Aggregates: sand, gravel, crushed stone, cinders.
- (b) Proportions; measuring, mixing and placing.
- (c) Construction of simple wood forms

FORGE AND VISE WORK

1. Forge Operations:

- (a) Cutting; bending in the bending fork; drawing, upsetting; forging flats, forging round to square, forging square to round; punching.
- (b) Welding.
- (c) Heat treating:
 - (1) Workability of various metals.
 - (2) Shop tests for distinguishing metals.
 - (3) Simple hardening of steel: heating, oil quenching, water quenching, testing.
 - (4) Tempering: preparation of steel, recognition of colour scale, quenching, testing.

2. Vise Work Operations:

- (a) Laying out; cutting with cold chisel, hack sawing, filing; bending, twisting; drilling, countersinking, riveting; finishing with abrasives.
- (b) Tapping and threading:
 - (1) Tap drill sizes; national coarse and national fine threads; precautions in use of taps.
 - (2) Threading with a die, adjustment of die; pipe threads and pipe sizes.

MACHINE SHOP PRACTICE

1. Hand Tools and Bench Work:

- (a) Extended use of hammers, chisels, punches, files, hack saws and vise.
- (b) Riveting, threading (taps and dies).

2. Layout Work:

- (a) Preparing metal surfaces to facilitate layout.
- (b) Use of common tools in laying out more difficult work from drawings.

3. Machine Tools and Operations:

- (a) Lathe: various turning operations between centres and on work mounted in chuck; knurling, cutting tapers.
- (b) Drill press: preparation of work for drilling; use of vise and V-block for mounting work; selection and mounting of drills.
- (c) Grinder: rough grinding, grinding to size, tool grinding.

ORNAMENTAL METAL WORK

1. Materials:

Copper, brass, aluminum, pewter; black iron and cold rolled steel; small diameter iron pipe; soft and hard solders, and fluxes.

2. Operations:

- (a) The operations of Grade IX extended to include the use of needle files; the use of special stakes for forming special shapes and edges in raising operations; surface decoration by line chasing and matting, and by the application of contrasting metals soldered or riveted in place.
- (b) Soldered and riveted butt and lap joints.
- (c) Finishing: acid cleaning to remove scale; hammered effects; high lighting and coloured finishes.

MOTOR MECHANICS

1. The Multi-cylinder Engine:

- (a) **Pistons:** study of relative position of pistons in various cylinders, relation of crank to stroke, purpose of flywheel; detail study of piston assembly including rings, pins, connecting rod and bearings.
- (b) **Valves:** study and adjustment of one type of valve arrangement.
- (c) **Timing:** an elementary study of ignition timing and valve timing applied to a simple engine.
- (d) **Lubrication system:** trace oil passage through the lubrication system for the engine; examine and operate an oil pump unit; study selection of motor oils for various temperatures and conditions.
- (e) **Cooling system:** trace water passage through the cooling system for the engine; examine parts such as water pump, thermostats, and radiator; anti-freeze solutions.
- (f) **Fuel system:** properties of gasoline; examine and test a fuel pump, trace fuel lines; examine a simple carburetor, adjust carburetor; clean lines and strainers.

2. Chassis Parts:

A more detailed study of the following parts: clutch, gear box, drive shaft, differential, brake, rear-axle assembly, front-axle assembly. These parts to be examined, taken down, and re-assembled.

3. General Care of the Automobile:

Tightening, removing squeaks, general lubrication.

SHEET METAL WORK

1. Hand Operations and Tools:

- (a) The operations of Grade IX applied to rectangular and circular objects.
- (b) **Laying out:** transferring dimensions from a blueprint or drawing to the sheet metal; use of indentations for locating bending lines on reverse side of material.

- (c) Cutting: use of straight and curved snips.
- (d) Folding and forming: use of hollow mandrel, blowhorn or improvised stakes in forming cylindrical-shaped objects.
- (e) Joining: objects involving seams and joints such as lap seam, hooked joint, double seam, corner lap joint, peined seam joint, grooved joint.
- (f) Soldering: tacking, application of solder to seam, penetration of solder into seam.
- (g) Reinforcing edges: the wired edge.

2. Machine Tools and Operations:

- (a) Names of main parts; proper use, adjustments and precautions to be observed for the bending brake, adjustable bar folder, slip roll former, the wiring, turning and burring machine.
- (b) Operations: folding, locking, rolling, wiring, turning and burring.

3. Machine Operations:

- (a) Adjustable bar folder: types of folds (open, close and double); setting and locking gauge.
- (b) Bending brake: method of operating for bending material in the construction of simple straight-lined objects.

4. Sheet Metal Finishes:

Methods of preparing various sheet metals to take protective or decorative coatings.

WOODWORKING

1. Materials:

- (a) Lumber: common Canadian woods, plywood, composition board, dowel rod.
- (b) Hardware: hooks, hinges and locks of various kinds.
- (c) Finishing materials: stains, fillers, shellac, varnish, pumice stone, rotten stone, paints.

2. Hand Tool Operations:

- (a) Laying out, sawing, planing, squaring and truing to size, chamfering, chiselling, shaping, boring, fastening, scraping, sanding and finishing.
- (b) Joints: butt, lap, half lap, rabbet, dado, mitre, dowel.
- (c) Fitting hand rip and hand cross-cut saws; sharpening tools such as scrapers and auger bits.
- (d) Gluing and clamping: gluing for width; gluing and clamping frames.

3. Machine Tools and Operations:

The machines must be adequately guarded and the guards kept in place. Operations that cannot be completed with the guards in place shall not be attempted.

- (a) Variety saw: cross-cutting and ripping.
- (b) Band saw: sawing curves.
- (c) Scroll saw: sawing scrolls, piercing.
- (d) Drill press: boring, sanding, mortising, shaping, routing.
- (e) Jointer: jointing edges and faces.

- (f) Lathe: rough and finish turning to size, shoulder and taper turning; turning more elaborate curves; larger face-plate work.
- (g) Grinder: grinding chisels, plane irons and lathe tools.

4. Home Mechanics:

The fundamental principles of woodworking applied to hanging doors, fitting locks, fitting window sash, glazing windows, re-finishing furniture, and other similar jobs about the home.

5. Finishing:

Staining, filling, shellacking, varnishing, rubbing; use of paints and enamels.

GRADE XI DRAFTING

1. Machine Drawing:

- (a) Detail and assembly drawings of machine parts or tools such as babbitted bearing, screw jack, and drill vise, which require more difficult placement and projection of views, auxiliary views and sectional views.
- (b) The use of catalogues, handbooks and reference books for details of machine parts, fastenings and fittings.
- (c) Layout of pipe lines, calculation of lengths, selection of pipe fittings.

2. Building Construction:

- (a) The drafting conventions more commonly used for indicating details of building construction; symbols for electrical work, plumbing and drains.
- (b) Floor plan layout and scale drawing of simple structure such as cottage or a farm building.
- (c) Simple sketching and layout plans indicating the use of building materials commonly employed in the community.

3. Landscape Drawing: Map-making to scale such as a layout for a garden, farm or park.

APPLIED ELECTRICITY

1. Circuits:

- (a) Measurement of voltage drop in light, heat or power circuits.
- (b) A circuit with a constant supply voltage and the load units connected in series-parallel and parallel-series and the current flow through each path recorded; resistances of different groupings.
- (c) Loss of energy due to heating of conductors; adequate size conductors.
- (d) Installation of branch circuits for light, heat and power, using non-metallic and metallic cable wiring, including lighting circuits controlled by one, two, three and four-point switches; a study of heating circuits in electric ranges, hot water heaters and electric grates.

2. Measuring Instruments: More extensive study of the action, construction and use of D.C. voltmeters and ammeters.

3. Magnetism:

- (a) An experimental study of electro-magnets to show the effect of strength of current, number of turns and material in core on the magnetic field of force.
- (b) Production and nature of induced currents, including the elementary laws of induction governing induced currents in conductors cutting magnetic fields; construction of a small transformer.

4. Motors and Generators:

- (a) Examination of typical D.C. generators and motors to determine their characteristics and the function of the various parts.
- (b) The principle of series, shunt and compound wound machines.
- (c) Stripping a small model D.C. motor or auto horn motor, making out data sheet and rewinding, using necessary tests as winding proceeds.

FARM MECHANICS

1. Lubrication: Grades and uses of lubricants for farm machines such as engines, electric motors, windmills, pumps and binders.

2. Tool Sharpening:

Use of grindstone, emery wheel, files and finishing stones in sharpening tools and implement cutters such as axes, hoes, cultivator points, binder and mower knives; jointing, setting and filing of hand and circular saws.

3. Rope Work and Tackle Blocks:

- (a) A more extensive knowledge of strength and quality of rope required for a variety of farm purposes.
- (b) Splices: short and long in heavy rope.
- (c) Blocks containing one, two, three and four pulleys.

4. Belts and Belt Splicing:

- (a) Leather, fabric and V-belts.
- (b) Practice in splicing by gluing, lacing, and using rawhide and metal fasteners.

5. Farm Repair Work:

Repair of farm implements involving operations in wood and metal such as replacing guards on cutter bars, sections in blades, adjusting binder knotters, replacing wooden slats and leather straps on binder canvases; grades of paint for farm buildings and equipment; simple harness repair jobs.

6. Concrete Work:

- (a) Selecting and testing aggregates.
- (b) Proportions and methods of mixing.
- (c) Construction of wood and metal forms.

7. Pipe Work:

- (a) Cutting, threading, fitting, and assembling pipe; sealing joints.
- (b) Installation and maintenance of valves and fittings.

FORGE AND VISE WORK

1. Forge Operations:

- (a) Cutting; bending with the use of forms, drawing, upsetting, forging flats, punching, twisting; making and using templates for testing curves and lengths of duplicate parts.
- (b) Brazing, welding; fastening with clips.
- (c) Heat treating; annealing, hardening, tempering, testing, case hardening.

NOTE: Precautions should be taken to avoid dangerous cyanide fumes in case-hardening operations.

2. Vise Work Operations:

- (a) Bending with the use of forms, twisting; drilling, countersinking, riveting; filing; hammering, raising of flat surfaces.
- (b) Cutting, bending and drilling tube material; finishing same.
- (c) Finishing with abrasives, flat black and bronze paint.

MACHINE SHOP PRACTICE

1. Hand Tools and Bench Work:

More difficult operations in riveting, threading (taps and dies), and filing to size.

2. Layout Work and Inspection Checking:

More advanced layouts involving use of surface plate, surface gauge, thread gauge and micrometer.

3. Machine Tools and Operations:

- (a) Lathe: extension of work in turning operations between centres and on work mounted in chuck; right hand, standard, V-thread cutting; external taper turning; drilling and boring; repair and upkeep of belting.
- (b) Drill press: drilling to layout including depth; use of countersink; spot facing; drawing holes to desired location; drilling for tapping; clamping of odd-shape work.
- (c) Grinder: grinding of lathe tool bits and drills; dressing of abrasive wheel; properties, selection and use of abrasives.

4. Fasteners:

Special uses, and practice in the use of rivets, machine screws, cap screws, stud bolts, set screws, taper pins, keys.

5. Calculations:

Application of mathematical principles to gear ratios, speeds and feeds, tapers and threads.

ORNAMENTAL METAL WORK

1. Materials:

The ferrous and non-ferrous materials in heavier gauges.

2. Operations:

- (a) The operations of Grade X applied to more intricate projects.
- (b) Brazing and welding of joints as an alternative to the use of rivets or machine screws.

- (c) Making and using special chasing or repoussé tools; making and using sand bags and pitch blocks.
- (d) The applications of heat to iron for making sharp bends and shaping ends.

3. Surface Decoration:

The work of this grade to be characterized by special attention to surface ornamentation.

- (a) Piercing, line chasing and repoussé.
- (b) Beading, fluting and turning of edges on dishes and bowls.
- (c) The application of simple castings in white metal or pewter sweated in place on flat work, shallow boxes or trays.
- (d) Decorative hinges, clasps, handles; ornamental rosettes and buttons.
- (e) Combination of copper, brass or aluminum with coloured plastics.
- (f) Hammered surfaces and edges.

4. Spinning: Spinning of small projects requiring the use of simple chucks.

MOTOR MECHANICS

1. The Engine:

- (a) Removing and replacing gaskets.
- (b) Piston displacement and compression ratio.
- (c) Removing and replacing pistons and connecting-rod assemblies.
- (d) Checking cylinder condition for wear.
- (e) Adjusting valves.

2. The Automotive Electrical System:

- (a) The battery: its care and service operations.
- (b) The starter and generator: general principles and simple service adjustments.
- (c) The lighting system: kinds of cables and terminals; types of lamp bulbs, adjustment of head lamps.
- (d) The ignition system: simple adjustments, such as cleaning distributor, adjusting spark plugs, servicing connecting wires.

3. Carburetion:

- (a) Principle and construction of the single-throat carburetor.
- (b) Cleaning and simple adjustments.

4. Transmission System:

- (a) Dismantling and assembling a clutch.
- (b) Study of the transmission unit: tracing path of power and determining speed ratio for each shift.
- (c) Examination of a rear-axle unit.

5. Running Gear:

- (a) The steering gear and front wheels: examination of a typical steering and linkage assembly.

- (b) Brakes:
 - (1) Examination of mechanical and hydraulic braking systems.
 - (2) Adjusting two types of brake shoes.
- 6. Traffic Regulations: A study of the important rules and regulations of the Ontario Traffic Act.

SHEET METAL WORK

- 1. Pattern Development:
 - (a) Parallel line and radial line development applied to such objects as scoops, funnels, pails, window boxes.
 - (b) Triangulation method of development applied to irregular shapes such as rectangular flaring pans and simple transition pieces (square to round).

NOTE: All patterns to be fabricated in metal to actual size.
- 2. Seams and Seaming Allowances:

Various types of seams; the amount of metal to make each seam; common uses and advantages.
- 3. Hand Tool Operations:
 - (a) Soldering: greater facility in the use of the soldering iron; sweat soldering.
 - (b) Riveting: use of rivet sets and punches; weights and sizes of rivets; spacing and punching rivet holes; blind riveting, forming rivet heads.
 - (c) Tinner's snips: use of straight, curved, double-cutting and scroll snips; care and sharpening of cutting blades.
 - (d) Making of objects involving dropped wire edges, hinge flaps, hasps, staples, dropped wire handles.
- 4. Machine Operations:
 - (a) The operations of Grade X applied to more difficult construction.
 - (b) The setting and adjustment of the machines to allow for gauge of material and for wired edges.

WOODWORKING

- 1. Materials:
 - (a) Lumber: common Canadian woods, plywood, composition board.
 - (b) Trimmings: bakelite fittings, compo carvings, transfers.
 - (c) Hardware: hinges, locks and catches of various kinds.
- 2. Hand Tool Operations:
 - (a) More difficult operations, such as sawing tenons and dovetails, shaping mouldings or band-sawn legs, scraping hard woods.
 - (b) Joints: stopped dado, mortise and tenon, dovetail, coped joint.
 - (c) Cabinet construction: use of housed joint, glue blocking, simple panel door construction.

3. Machine Tool Operations:

- (a) Safety precautions, care and proper operation of machine tools.
- (b) The care, adjustment, and fitting of all attachments to the machines.
- (c) Variety saw: cutting grooves, dados, mitres.
- (d) Band saw: sawing curves.
- (e) Scroll saw: sawing curves, inlaying.
- (f) Drill press: boring operations, cutting mortises, simple shaping and routing.
- (g) Jointer: surfacing, jointing edges, cutting rabbets.
- (h) Lathe: turning matched parts as legs, pairs of candlesticks; turning ornaments, knobs; turning glued-up work.
- (i) Drum and disc sanding operations on the lathe when there is no special machine available.

4. Wood Finishing:

- (a) The use and care of finishing materials, particularly of brushes.
- (b) More advanced knowledge of water and oil stains; mixing of fillers; use of shellac, varnish, and lacquer.
- (c) More expert treatment of rubbing and polishing; the refinishing of used furniture.

NOTE: If desired, the woodworking courses in Grades XI and XII may be organized to provide more emphasis upon building construction.

GRADE XII

DRAFTING

1. Machine Drawing:

- (a) Detail drawings of machine parts or simple mechanical equipment from notes and sketches prepared by examining and measuring the actual objects. The drawings should indicate machine operations and materials, and give all dimensions and data necessary for duplicating the part.
- (b) Assembly and detail working drawings of mechanical devices or tools such as pulley transmission, flanged coupling, stuffing box, pump parts or simple machines; standard fastenings, machine bolts, cap screws, set screws, keys and key seats.
- (c) Inking, tracing and blueprinting.

2. Building Construction:

- (a) Drawings for a simple one-storey frame building such as a summer cottage, barn, workshop or farm building.
- (b) Detail drawings for carpentry work such as door and window frames, roof framing, cupboards, work benches, stairs.
- (c) Bill of material: listing quantities and compiling order forms for materials required to fabricate the objects shown on the working drawings.

3. Isometric Drawing:

Principles of drawing straight line objects and circles in isometric.

4. Development of Surface:

- (a) Intersections: plotting the lines of intersections of cylindrical and rectangular shapes joining at various angles such as in T-pipes, branch pipes, elbows, and gutters.
- (b) Pattern layout applying parallel line method of development to such objects as three-piece elbow and T-pipes.
- (c) Radial line method applied to such objects as oblique cut cones, ventilators, tapered containers.

APPLIED ELECTRICITY

1. Materials:

Specification of trade materials; recognition of wire sizes; interpretation of current publications within the scope of the course.

2. Circuits:

- (a) Splices and joints: construction and uses of more difficult joints; soldering, waterproofing; attaching terminal lugs.
- (b) The installation of fractional motors using starters and protective devices.

3. Testing and Repair:

- (a) Testing and repairing heat, light and power circuits in both 115 and 115-230-volt systems.
- (b) Stripping, securing winding data and rewinding one small A.C. motor armature; making all necessary tests before, during and after winding: truing up commutator, undercutting mica and complete check-up before assembling for running test.

4. Magnetism:

A study of electro-magnetism as related to alternating current as used in A.C. motors and generators; the characteristics and underlying principle of some common types of A.C. motors and generators.

5. Apparatus:

The design and construction of simple electrical apparatus to demonstrate the application of electrical principles, such as crystal sets, transformers, electro-magnets, resistances, meters, motors, bell, buzzer, telegraph key, telephone, relays, mercury switches, the apparatus in every case to operate on low potential.

FARM MECHANICS

1. Tool Sharpening:

- (a) Uses of various grinding wheels and the dressing tool.
- (b) Grinding and whetting tools such as gouges, veining tools, auger bits, twist drills, knives on cutting boxes.
- (c) Fitting hand and power saws.

2. Rope Work and Tackle:

- (a) Grade XI extended to include the use of various blocks, wire stretchers and hoists.

- (b) Specifications for rope and pulleys for farm requirements.
- (c) Methods of roping farm animals for tripping, throwing and tying.

3. Construction and Repair:

- (a) Construction of projects in wood and metal for the farm such as hot bed with sash, bee hive and accessories, poultry house, movable hog pen or model, arbor, wagon rack; making and replacing handles.
- (b) The use of the framing square in the layout of common hip and jack rafters.
- (c) Repair, replacement and adjustment of parts of mechanical equipment such as pumps, windmills and mechanisms of farm implements.

4. Concrete Work:

- (a) Care and theory of operation of concrete mixing machines.
- (b) Construction and use of irregular wood and metal forms for gate posts, curved walks, stable flooring, mangers and troughs.
- (c) Reinforcing concrete.

5. Pipe Work:

- (a) More advanced work in cutting, threading, fitting and assembling pipe.
- (b) Making and installing floats of various types.

FORGE AND VISE WORK

1. Forge Operations:

- (a) Cutting; bending scrolls, drawing, upsetting, forging flats, punching, offsetting; use of templates on curves and duplicate parts: shrinking on bands and collars; tapering round and square stock; shaping eyes and rings.
- (b) Brazing, welding; fastening with clips.
- (c) Forging of various tools from tool steel.
- (d) Heat treatment.
- (e) Moulding and casting:
 - (i) Simple moulding equipment; draft, shrinkage, procedure in making two-part moulds; moulds including simple vertical and horizontal cores.
 - (ii) Simple castings of lead base white metal.

2. Vise Work Operations:

- (a) Bending with the use of jigs, twisting; drilling, countersinking, riveting; filing; hammering, raising of flat surfaces.
- (b) Finishing with abrasives, enamel, lacquer; hammer finishing; ornamenting by use of rosettes and ornaments.

MACHINE SHOP PRACTICE

1. Hand Tools and Bench Work:

- (a) Use of file and scraper in production of a flat surface.
- (b) Use of reamers.
- (c) Machine and small tool repair.

2. Layout and Gauging:

- (a) Use of pilot holes for large diameter drills.
- (b) Accurate use of gauges.

3. Machine Tools and Operations:

- (a) Lathe: spotting and drilling; cutting standard national threads; internal thread cutting; taper turning.
- (b) Drill press: counterboring; drilling thin metal.
- (c) Grinder: use of different abrasive wheels for rough and tool grinding; mounting of wheels; grinding tool bits and drills.

4 Metallurgical Work:

An elementary study of the metals in use such as iron, steel, brass, bronze, aluminum, with regard to their structure, methods of identification, physical properties, necessary working lubricants; practice in annealing, hardening and tempering.

5. Materials:

Trade names, processes, stock materials and sizes, approximate costs.

ORNAMENTAL METAL WORK

1. Operations:

- (a) The operations of Grade XI extended.
- (b) The use of a draw plate for making wire of various shapes.
- (c) The setting of semi-precious stones and the making of special tools as required.

2. Surface Decoration:

The ornamentation of Grade XI extended to more elaborate projects consisting of a single piece or of a number of pieces soldered together.

3. Spinning:

Spinning of work requiring the use of two or more chucks.

MOTOR MECHANICS

1. The Engine:

- (a) Making and fitting paper gaskets.
- (b) Grinding valves (hand method).
- (c) Adjusting valves (running engine).
- (d) Cooling system: cleaning and flushing; replacing pump packing; fitting hose connections.
- (e) Tuning a running engine.

2. The Automotive Electrical System:

- (a) Simple care and service adjustments to starter, generator and battery circuits.
- (b) Tracing and rectifying troubles on lighting circuits; installing fuses and relays.

3. The Ignition System:

- (a) Firing orders for four and six-cylinder engines; wiring for one firing order.
- (b) Low and high tension circuit; purpose of coil, condenser, breaker and distributor.
- (c) Cleaning, adjusting and replacing spark plugs; detecting faulty plugs on running engine.

4. Carburetion:

- (a) Adjusting carburetor on running engine.
- (b) Cleaning gas lines, bowls and strainers.

5. Transmission and Running Gear:

- (a) Dismantle and assemble simple gear box.
- (b) Dismantle and assemble simple rear axle.
- (c) Adjustment of front wheel bearings.
- (d) Adjustment of steering gear.

6. Traffic Regulations:

A further study of the rules and regulations of the Ontario Traffic Act.

SHEET METAL WORK

1. Pattern Development:

An extension of the methods of developing patterns applied to objects such as two and three-piece round and rectangular elbows, tees, flaring pans, lips on cylindrical containers, mitred joints on eave-troughing and cornice mould.

2. Hand Tool Operations:

- (a) The operations of the previous grades applied to more advanced projects.
- (b) Cutting and joining mitred joints.
- (c) Assembling eave-troughing and cornice mould (to include straight and mitred joints).

3. Machine Tool Operations:

- (a) The operations of Grade XI extended.
- (b) Bending brake: adjusting for tension on various gauges of metal.
- (c) Wiring machine: use of elbow edging heads.

WOODWORKING

1. Materials:

- (a) The materials of Grade XI extended.
- (b) Imported woods; veneers.

2. Hand Tool Operations:

- (a) The hand operations of the previous grades applied to more difficult projects made up of several pieces.
- (b) Surface decoration: mouldings, simple carving, veining, inlaying, simple veneering.
- (c) The care and sharpening of all hand tools.
- (d) Upholstery: upholstered seat or stool.

3. Machine Tool Operations:

- (a) Squaring stock by machine methods.
- (b) Production methods using special tools and jigs:
 - (1) Band saw and scroll saw: compound sawing, pad sawing, pattern sawing, resawing.
 - (2) Drill press: plug and dowel cutter, spur bits, rosette cutters, pattern routing, pattern sanding.
 - (3) Circular saw: cutting tenons with the tenoning attachment; use of the moulding head and dado head.

4. Pattern-making: Simple solid, split and cored patterns.

5. Finishing:

The operations of Grade XI continued to provide for greater skill in the use and a more extended knowledge of finishing materials.